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SUBTASK MEMORANDUM

Task: 1.3 Adequacy and validity of meteorological measurements

Subtask: 4 Assess the validity of the two-component sodar data collected during stagnation periods

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A review of two-component sodar and conventional meteorological data at the Angiola site was performed for data collected during December 2000, with an emphasis on periods of stagnation. The original intent was to compare the NOAA two-component sodar with the sonic data collected on the 100-m tower. Sodar data that corresponds to the 25-m and 45-m levels of the tower are missing, apparently due to noise or reflections at those gates. This left only sonic data collected at the 100-m level available for comparison. However, a quick review of the sonic data by plotting vertical wind speed as a function of wind direction (**Figure 1**) reveals that the sonic data collected at the 96-m level has problems. The high quality of the sonic data collected at the 26-m and 47-m levels is discussed in the analysis memo for subtask 2. Looking at Figure 1, it is readily apparent that the 96-m data is not representative of the actual winds at the tower, at least without additional processing. First, there is an obvious shift in the prevailing direction of the winds. The 26-m and 47-m data are in good agreement, showing the prevailing winds out of the north-northwest. The prevailing winds shown at the 96-m level are more out of the north. Second, the 96-m vertical wind speeds show an obvious and very pronounced positive bias when winds have a northeasterly component, and a negative bias when winds have a southwesterly component. Both of these observations imply a tilting or turning of the sonic anemometer, compromising the usefulness of the 96-m data without further information regarding its mounting and further processing of the data.

Thus, comparing the sodar data with the sonic data was not possible. The overall quality of the mechanical sensors on the 100-m tower was also discussed in the subtask 2 memo. The 98-m mechanical wind speed and direction data therefore is suitable for comparisons with the sodar data. **Figure 2** presents scatterplot comparisons between the sodar and tower data, stratified by wind speed. In general, there is good agreement between the two methods when wind speeds are greater than 1 m/s, though the agreement is more apparent for wind direction than it is for wind speed, where there is considerable scatter. At wind speeds less than 1 m/s, the agreement is less obvious, and becomes almost random for wind speeds less than 0.5 m/s.

Table 1 summarizes the results of the comparisons. The poor correlation between wind speeds measured by the two systems is again emphasized, though part of this is due to the small range interval being compared. For example, by expanding the comparison range from 0.5 m/s to 1 m/s, one not unexpectedly sees an improvement in correlation, though it remains poor for wind speed.

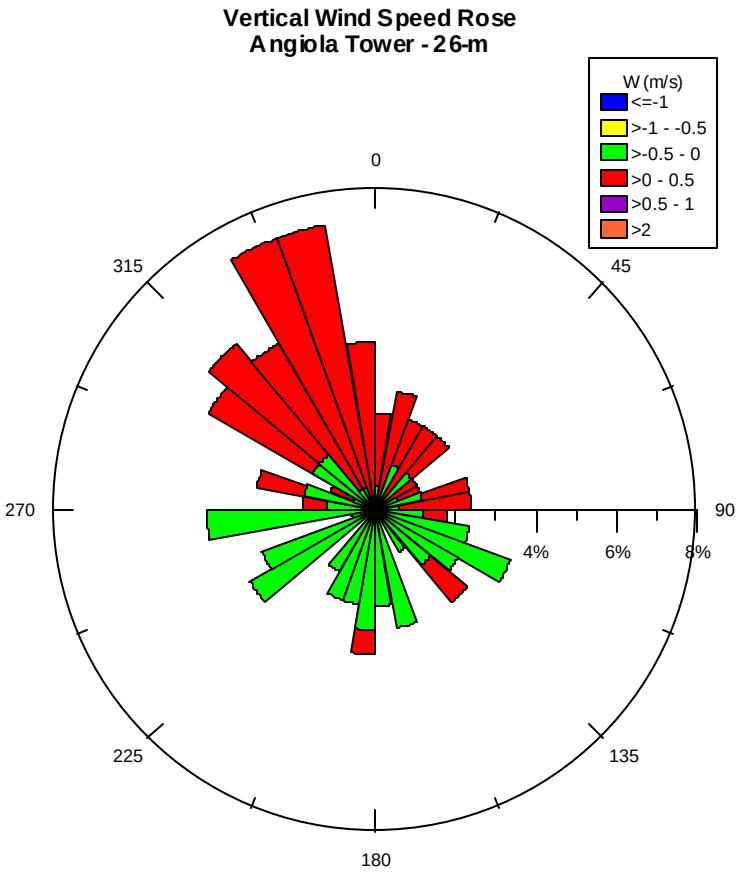
Table 1. Mechanical vs. Sodar Comparison

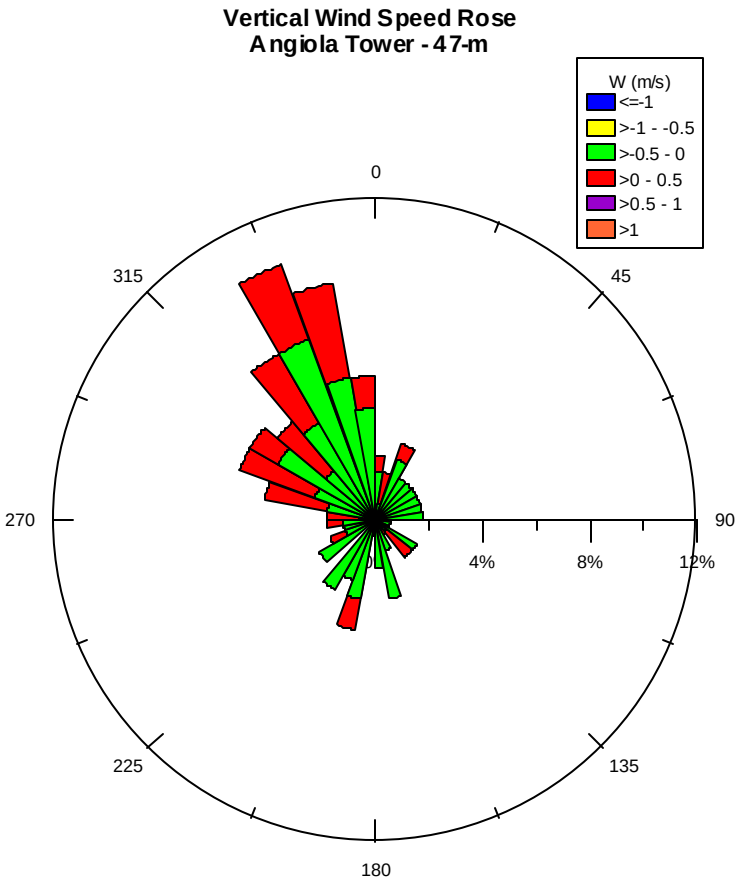
Mechanical WS (m/s)	Correlation (r)		Average WS (m/s)		N
	WS	WD	Mechanical	Sodar	
0 – 0.5	0.263	0.775	0.30	0.57	24
0.5 – 1	0.018	0.886	0.77	0.86	56
0 – 1	0.303	0.828	0.61	0.77	80
> 1	0.823	0.960	2.71	2.24	215

One possible source of error for the two-component sodar is the inability to correct for the possible effect of vertical wind speed on the reading. To investigate this, differences between the sodar winds and the tower winds were plotted as a function of the tower vertical wind speed (**Figure 3**). For this comparison, vertical wind speeds for the 47-m level were used, since the 98-m vertical wind speeds were problematic as noted above. As Figure 3 shows, there appears to be no relationship between vertical wind speed and the differences between the two wind measurement methods.

Despite the poor reported correlation between the two methods for low wind speeds, the overall average for the two methods compare well, even at the low wind speeds. In general, the sodar appears to underestimate low wind speeds and overestimate higher wind speeds, though the difference is not large. The question therefore was whether or not the poor correlation actually had a significant effect on analysis, given that the overall average of the reported wind speeds generally agreed. To investigate this, two simple 12-hour back trajectories were generated for two relatively stagnant periods at the tower, using both sodar and mechanical sensor data. As can be seen in **Figures 4 and 5**, data from the two wind measurement methods leads to notably different results, with “sources” differing by 15 to 20 km.

In conclusion, it appears that there are significant differences between winds measured using the two-component sodar and those measured by conventional mechanical wind sensors, especially for wind speed. Given the more physically direct measurement methodology of the mechanical sensors and their proven agreement with the sonic anemometers, it appears that the differences are due to inaccuracies and limitations with the sodar measurements. The use of the sodar data at low wind speeds introduces additional uncertainty into the analysis.





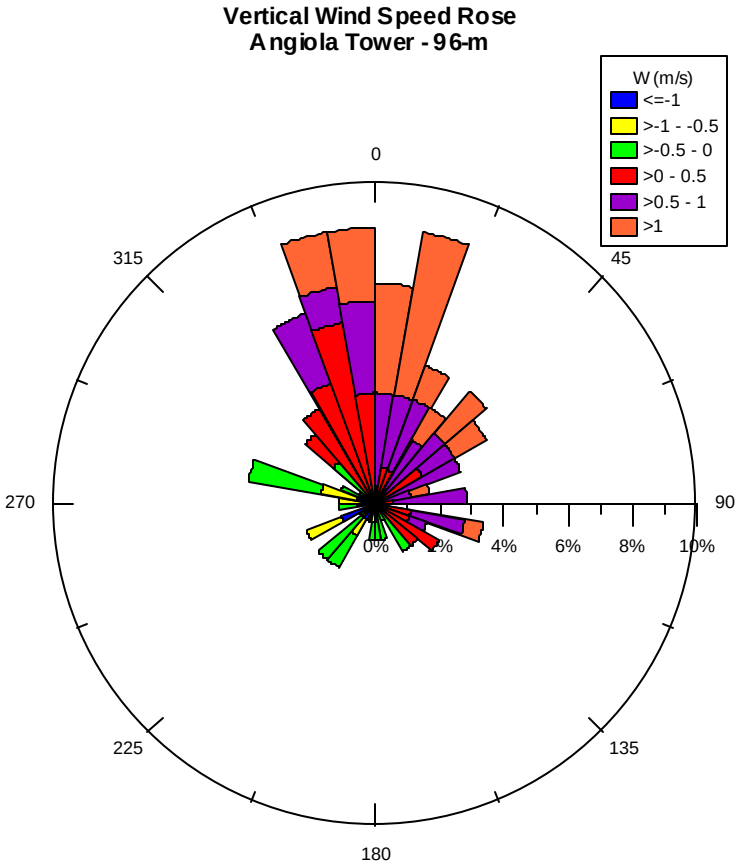
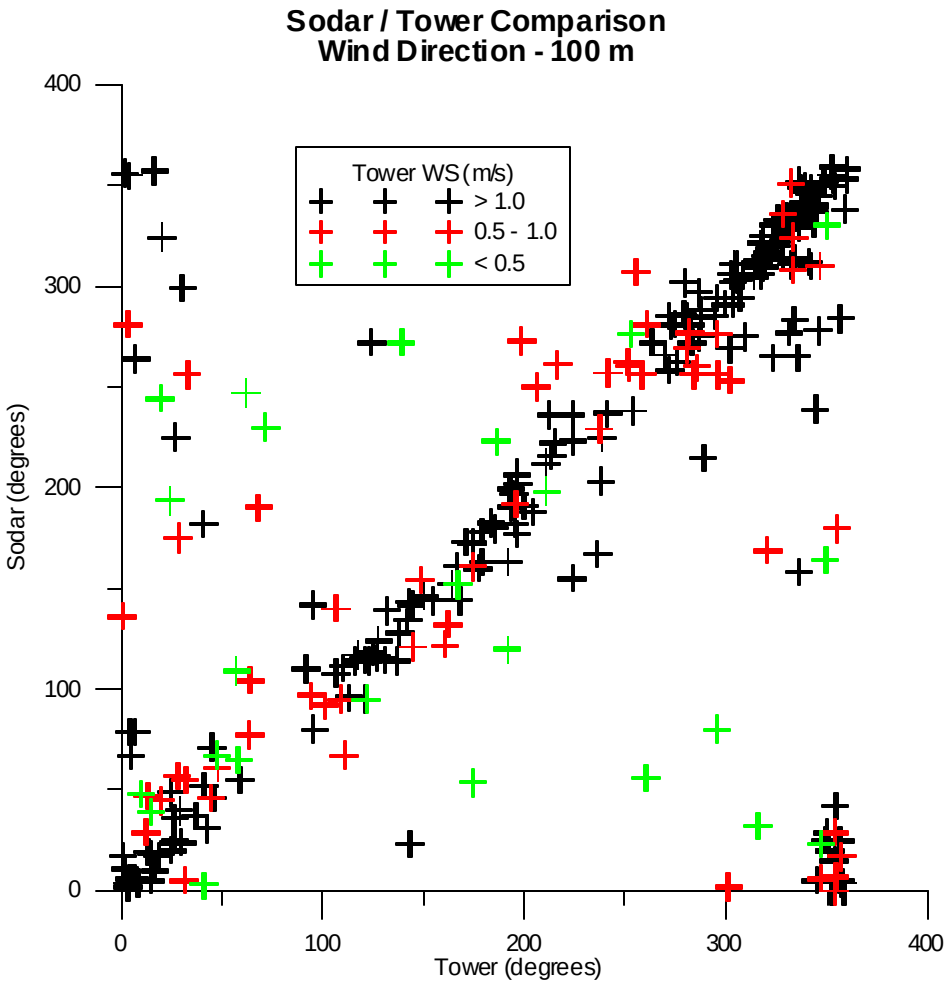


Figure 1. Vertical wind speed vs direction



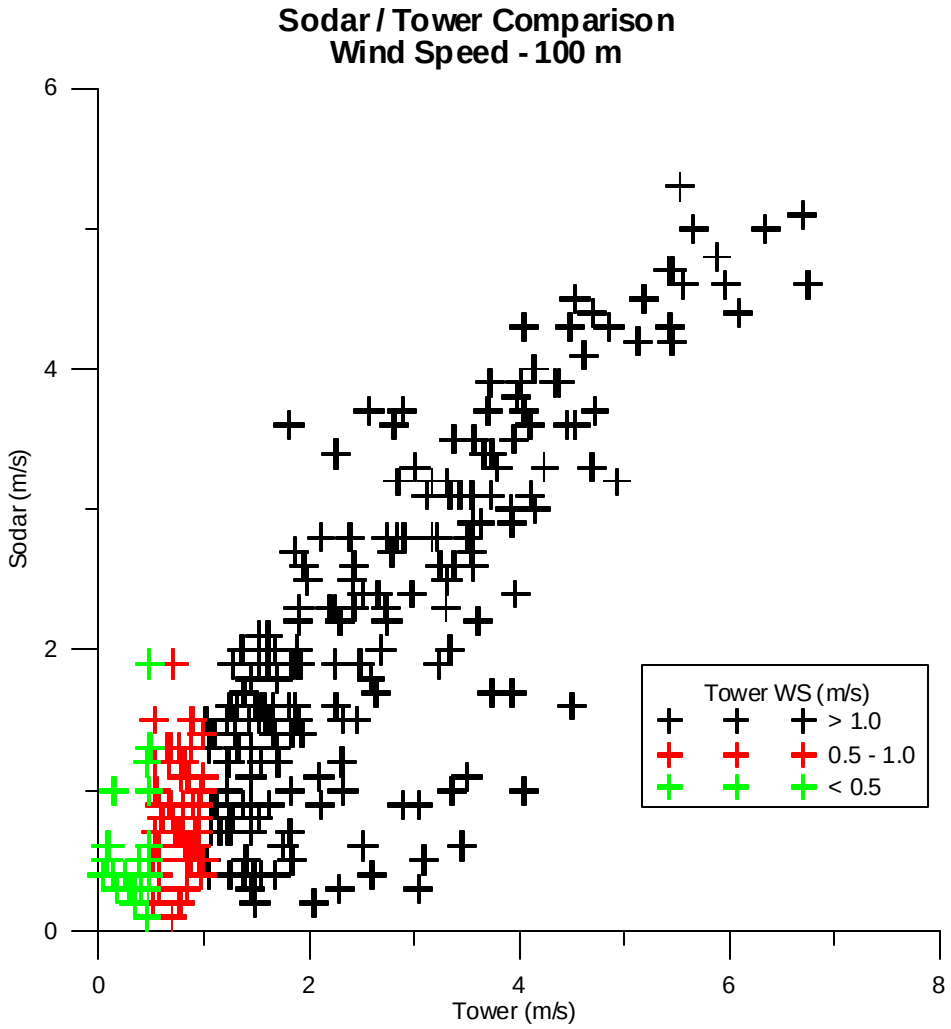
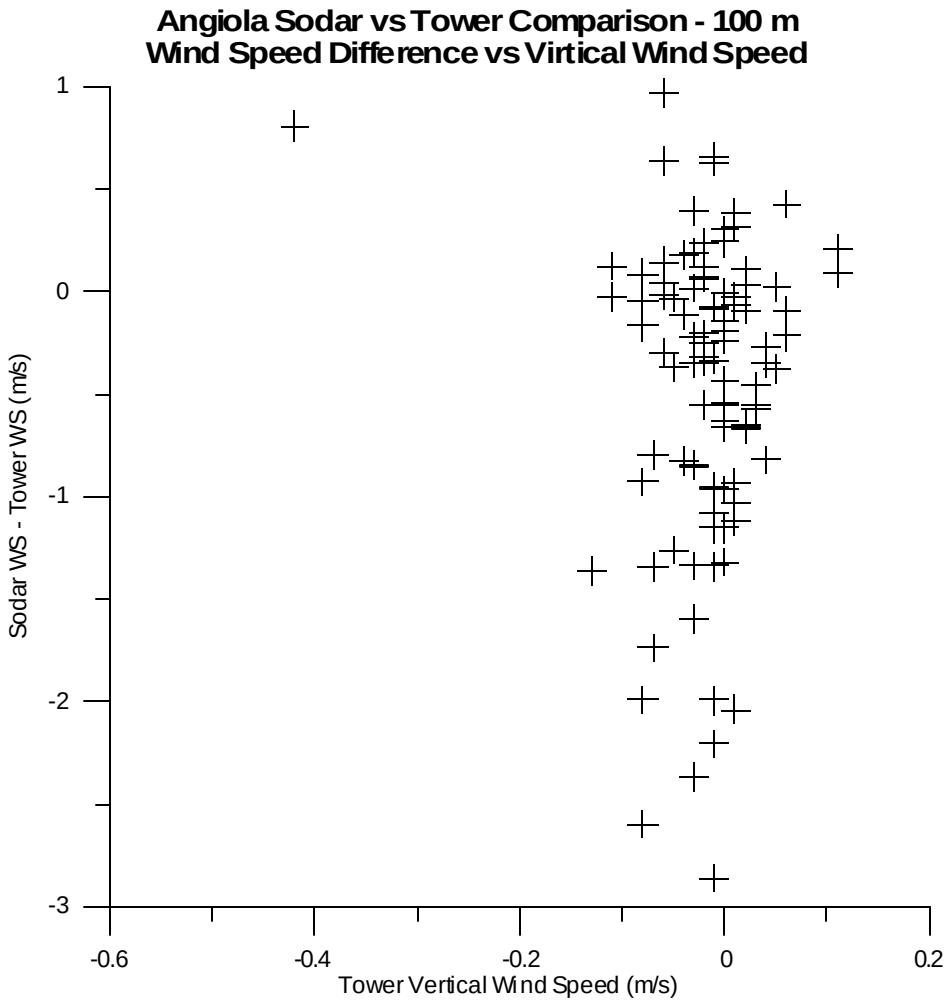


Figure 2. Comparison of sodar and tower (mechanical sensors) wind data – December 14 – 31, 2000.



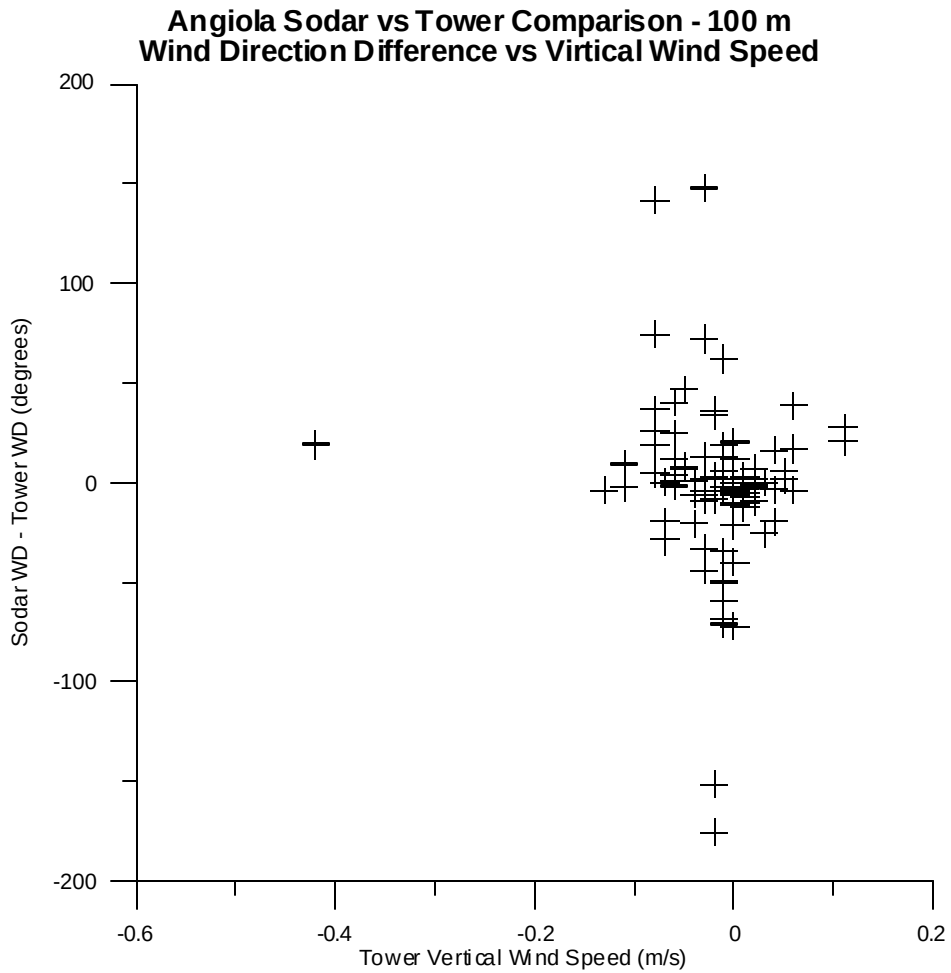


Figure 3. Effect of vertical wind speed on sodar measurements.

Figure 4. Back Trajectory for 12/17/00 (average WS = 1.18 m/s)

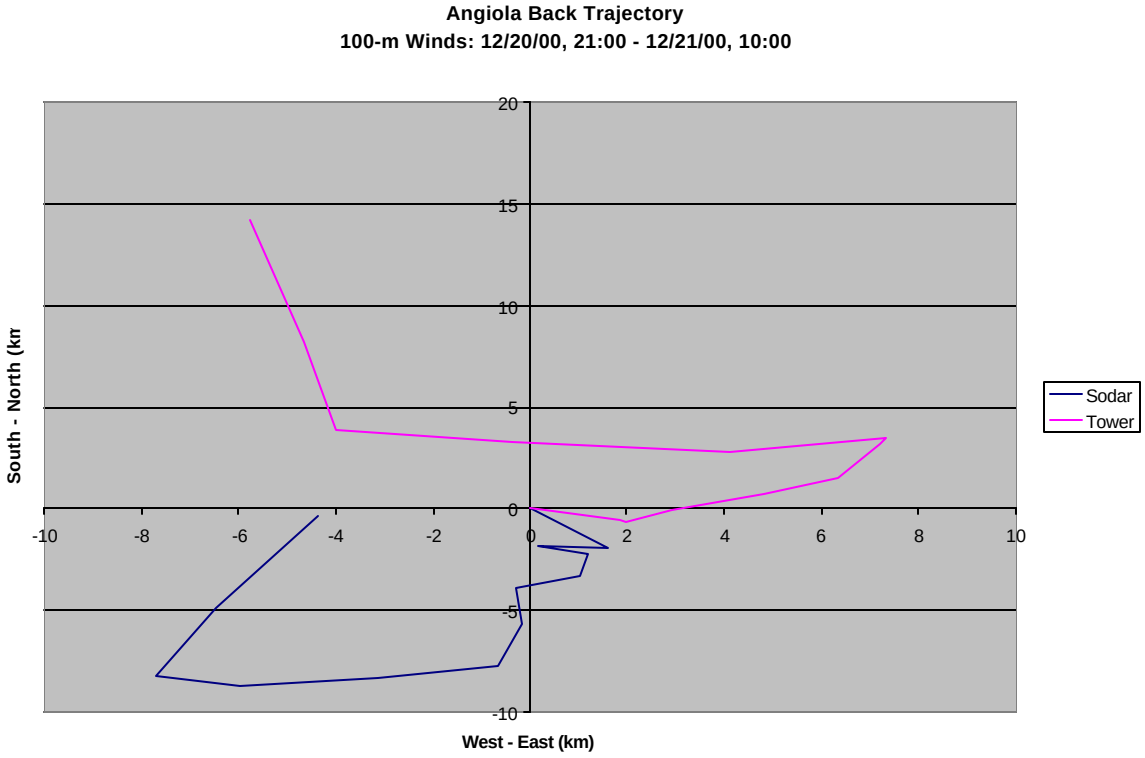


Figure 5. Back Trajectory for 12/20/00 (average WS = 0.72 m/s)